



SDMS Doc ID 2014583

Master Response on Perchlorate

INTRODUCTION

The Draft Program Environmental Impact Report (PEIR) has identified the potential for increased perchlorate concentrations in groundwater wells as a potentially significant impact of the Proposed Project. Mitigation has been proposed to reduce this impact to less than significant by providing treatment for any drinking water supplies that exceed public health standards based on monitoring the quality of groundwater produced from drinking water wells located near the proposed groundwater recharge areas. Proposed mitigation includes working with the well owners to bring their drinking water supply into compliance by either providing domestic water service from the CVWD or DWA domestic water systems or by providing appropriate well-head treatment, if monitoring shows that the groundwater pumped from these wells exceeds any health-based drinking water standard due to recharge activities.

Perchlorate (ClO_4^-) is a contaminant from the solid salts of ammonium, potassium or sodium perchlorate. Ammonium perchlorate has been used as an oxygen-adding component in solid fuel propellant for rockets, missiles and fireworks. Perchlorate compounds are also used in air bag inflators, nuclear reactors, electronic tubes, lubricating oils, electronic plating, aluminum refining, leather tanning and finishing, rubber and fabric manufacture and in the production of paints, enamels and dyes. Perchlorate is highly mobile in water and can persist under typical groundwater and surface water conditions for decades. Perchlorate is known to interfere with the uptake of iodine by the thyroid gland. Because iodine is an essential component of thyroid hormones, perchlorate disrupts the function of the thyroid gland. Perchlorate is among the unregulated chemicals requiring monitoring (Title 22, California Code of Regulations §64450). It is "unregulated" because it has no drinking water standard or maximum contaminant level (MCL).

PERCHLORATE STANDARDS

Several commenters stated that Colorado River water contains "dangerous" levels of perchlorate and that any perchlorate in the recharge water was unacceptable. These conclusions are a function of the criteria used to determine the significance of the perchlorate concentrations in Colorado River water. Therefore some explanation of the development of perchlorate regulations is needed.

There are some misconceptions regarding the current health standards for perchlorate. First, there is no adopted enforceable standard for perchlorate in drinking water. The US Environmental Protection Agency's (EPA) National Center for Environmental Assessment (NCEA) issued a draft toxicity assessment for perchlorate that included a draft reference dose (RfD) of 0.00003 milligrams per kilogram per day (mg/kg/day). The RfD is defined as an estimate, with uncertainty spanning perhaps an order of magnitude (ten-fold), of a daily exposure to the human population (including sensitive subgroups such as pregnant women, children and people with compromised thyroid conditions) that is likely to be without appreciable risk of

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adverse effects over a lifetime. EPA used a lowest observed adverse effects level (LOAEL) of 0.01 mg/kg/day as determined from animal studies. This LOAEL was divided by a composite uncertainty factor of 300 that accounts for 1) human sensitivity, 2) the duration of health studies and 3) database quality to compute the draft RfD of 0.00003 mg/kg/day.

The EPA assessment provided a hypothetical conversion of the draft RfD to a drinking water equivalent level (DWEL), assuming factors of 70 kilograms (kg) for body weight and 2 liters (L) of water consumption per day. The converted draft estimate would be 1 microgram per liter ($\mu\text{g/L}$) or 1 part per billion (ppb), assuming drinking water is the sole source of perchlorate. If EPA were to make a determination to regulate perchlorate, the RfD along with other considerations would factor into the final value. At this point in time, the EPA has not determined whether to regulate perchlorate in drinking water. If the EPA decides to regulate perchlorate, the RfD along with other health effects information, economic considerations, and technical feasibility would be used to establish a federal MCL. However, any federal standard would be established after California promulgates its own MCL. The Safe Drinking Water Act requires that any California drinking water standard must be at least as stringent as the federal MCL.

On its website, EPA states: "As with any EPA draft assessment document containing a quantitative risk value, that risk value is also draft and should not at that stage be construed to represent EPA policy. Thus, the draft RfD for perchlorate is still undergoing science review and deliberations both by the external scientific community and within the Agency." (emphasis added). The draft RfD is not an adopted standard. Instead, it serves as a starting point for establishing a drinking water standard. The RfD is currently undergoing scientific peer review; a report by its peer review committee was released in June 2002. EPA is currently reviewing the peer review report and public comments. EPA expects to release a revised draft; however, no date has been given for its release. Given the on-going review, it is premature to ascribe a maximum perchlorate concentration based on the current draft risk assessment.

Similarly, the State of California Office of Environmental Health Hazard Assessment (OEHHA) issued a draft public health goal (PHG) for perchlorate of 6 $\mu\text{g/L}$. This PHG was based on results of human studies that established a "no observed adverse effects level" of 0.01 mg/kg/day and an uncertainty factor of 30. The PHG is calculated using a 65 kg body weight, 2 L/day water consumption and 60 percent of daily perchlorate exposure from drinking water. A public workshop on the PHG was held on April 29 and a revised draft should be available by late summer 2002. OEHHA expects to finalize the PHG by the end of 2002.

The California Department of Health Services (DHS) established a health-based action level for perchlorate of 18 $\mu\text{g/L}$ in 1997. The California Health & Safety Code §116455 requires a drinking water system to notify the governing body of the local agency in which users of the drinking water reside (*i.e.*, city council and/or county board of supervisors) when a contaminant in excess of an action level or a MCL is discovered in drinking water well, or when the well is closed due to the contaminant's presence. DHS recommends that the drinking water system take the source out of service if a contaminant is present at more than 10 times the action level. In the case of perchlorate, this would currently be a concentration of 40 $\mu\text{g/L}$.

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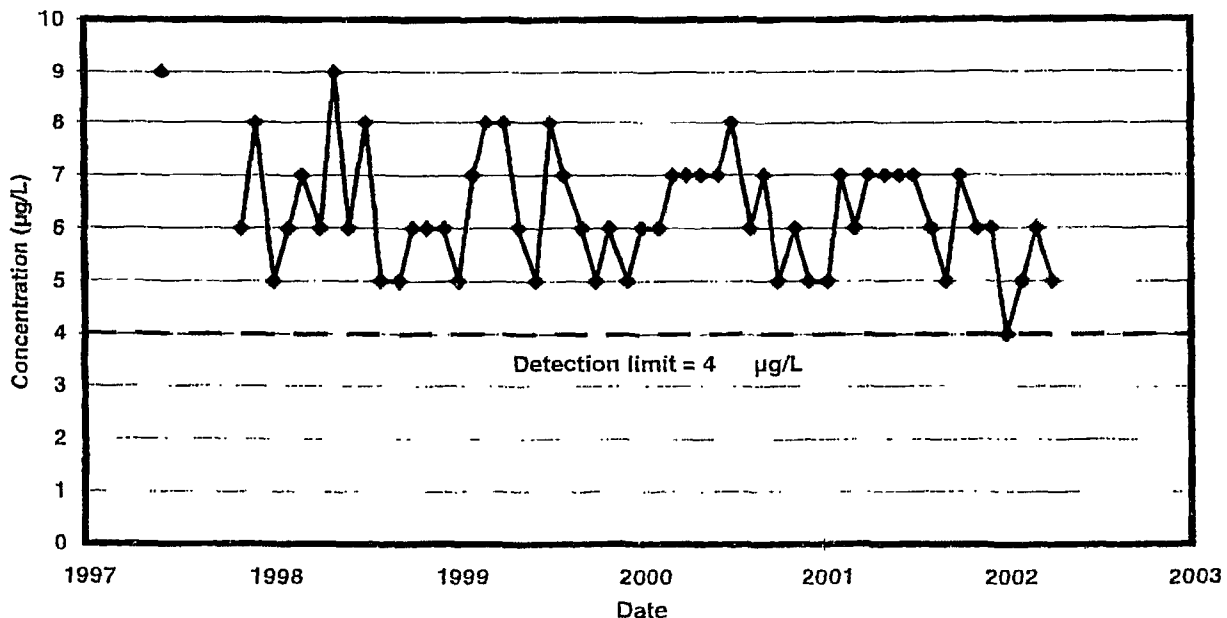
In January 2002, the EPA NCEA released a draft revised risk assessment for perchlorate which concluded that the health risks associated with perchlorate are greater than previously determined. As a result of the release of the draft NCEA health risk assessment, DHS lowered its action level for perchlorate from 18 $\mu\text{g/L}$ to 4 $\mu\text{g/L}$, which is the detection limit (January 2002). Senate Bill 1822 (Sher), which calls for OEHHA to establish a PHG by January 1, 2003 and for DHS to adopt a primary drinking water standard by January 1, 2004 signed by the Governor on September 8, 2002..

In summary, it is premature to adopt a drinking water standard for perchlorate concentrations without considering the scientific evidence. Consequently, the current action level of 4 $\mu\text{g/L}$ is used as a threshold for significance recognizing that the ultimate MCL could be higher than the action level.

SOURCE AND DISPOSITION OF PERCHLORATE

Perchlorate was initially detected by Metropolitan at a level of 9 $\mu\text{g/L}$ at Lake Havasu (see Figure 5-8 of the Draft PEIR and repeated below). Recent measurements at Lake Havasu have been in the range of 4 to 6 $\mu\text{g/L}$. In 2001 and 2002, IID detected perchlorate in the All-American Canal system ranging from 4.2 to 5.3 $\mu\text{g/L}$.

Figure 1
Perchlorate Concentrations in Colorado River Aqueduct Water



The source of perchlorate in Colorado River water has been determined to be the Kerr-McGee Chemical Company and the former PEPCON perchlorate manufacturing facilities in Henderson, Nevada. Perchlorate waste from decades of poor disposal practices has permeated into the groundwater under the manufacturing site which flows into Las Vegas Wash and then into Lake

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Mead. Kerr-McGee, working with the Nevada Division of Environmental Protection (NDEP), constructed a slurry wall to slow the migration of the perchlorate plume to Las Vegas Wash, began extracting perchlorate-contaminated groundwater, and has operated an interim 450 gpm groundwater treatment system since 1999. Kerr-McGee began operation of a larger (825 gpm) treatment facility in late March 2002 (S. Crowley, Kerr-McGee, pers. comm. 2002) which is expected to significantly reduce the perchlorate entering Lake Mead (Metropolitan, 2002b).

The Southern Nevada Water Authority (SNWA) monitors the quality of water in Las Vegas Wash and reports that the concentration of perchlorate has fallen by approximately 40 to 50 percent in less than two years (K. Vickman, SNWA, pers. comm., 2002). Similarly, Metropolitan has observed similar reductions since 1997. The future perchlorate concentration in Colorado River water that reaches the All-American and Coachella Canals is difficult to predict because of diluting river flows and Lake Mead levels whose variability depends on meteorological factors and river operations. Metropolitan is working with a consultant to develop a perchlorate washout model. This model is expected to show the future expected perchlorate levels at their Lake Havasu diversion. The USBR and the SNWA are potential partners in this effort (Metropolitan, 2002b). Nevertheless, perchlorate concentrations are anticipated to decrease further over time.

PERCHLORATE TREATMENT

Several commenters suggested that perchlorate mitigation should include pre-recharge treatment and requested cost comparisons for pre-recharge and post-extraction treatment. The available treatment methods and the cost of treatment prior to recharge are discussed below.

Perchlorate Treatment Alternatives

In addition to site remediation, perchlorate can be separated from drinking water using a variety of technologies.

Treatment options for perchlorate removal from drinking water include physicochemical processes such as granular activated carbon (GAC) adsorption, ion exchange, and membrane separation, and biological processes such as anaerobic treatment. Because perchlorate is highly oxidized and does not absorb radiation in the ultraviolet light spectrum, neither oxidation technologies (e.g., ozone or UV/hydrogen peroxide) nor ultraviolet irradiation (e.g., low pressure, medium pressure, or pulsed UV) reduce perchlorate.

Removal by GAC is difficult and expensive because of the high solubility of perchlorate. The efficiency of ion exchange is reduced because ions such as nitrate and sulfate interfere with perchlorate adsorption. Also, regeneration of the ion exchange resin creates a salt brine that can cause disposal problems because of high perchlorate concentrations. Note that ion exchange is viable as a site remediation strategy when extremely high levels of perchlorate occur, e.g., in contaminated groundwater (100,000 – 300,000 µg/L). It is less effective when concentrations are less than 100 µg/L. Recent pilot tests of ion exchange treatment for perchlorate removal indicate that trace amounts of N-nitrosodimethylamine (NDMA), a known animal carcinogen, are released into the product water from the ion exchange resins.

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Reverse osmosis and nanofiltration membranes are effective removal technologies but merely transfer the perchlorate to the waste brine. Biological treatment has been shown to be effective with highly contaminated wastewater and groundwater. It is not clear whether bioreactors would produce potable drinking water from sources with the low levels of perchlorate, such as found in drinking water supplies. DHS, however, recently issued conditional approval for the use of a biological process using a fluidized bed of granular activated carbon for perchlorate removal from water that is a potential source of drinking water supply. Biological treatment requires the addition of a carbon source such as ethanol and nutrients to the water for microbial growth. At this time, there are too little operational data available to show that large-scale use of biological treatment for low levels of perchlorate is feasible.

Implementation of any of these technologies could take up to five years. Remediation at the source is a more effective method for reducing perchlorate levels within a comparable timeframe.

Perchlorate Treatment Costs

Given the shortcomings of the other processes, ion exchange has been applied in a number of locations to remove perchlorate. Options for ion exchange treatment include pre-treatment before recharge and post-treatment of the extracted groundwater.

Ion exchange treatment prior to recharge in the Coachella Valley would require three facilities having the following capacities:

Table 1
Perchlorate Treatment Facilities Design Capacities

Facility	Design Capacity ¹	Average Annual Flow
Whitewater Spreading Facility	250 mgd	140,000 acre-ft/yr ²
Dike 4 Spreading Facility	72 mgd	40,000 acre-ft/yr
Martinez Canyon Spreading Facility	72 mgd	40,000 acre-ft/yr

1 Design capacity is based on recharging the average annual flow within a six month off-peak demand period.

2 Note that the average recharge at Whitewater would be 140,000 acre-ft/yr through 2007, decreasing to 103,000 acre-ft/yr by 2013.

The capital cost for ion exchange treatment facilities would be \$260 million at the Whitewater facility and \$74 million each for the Dike 4 and Martinez facilities, exclusive of brine disposal costs. The total capital cost for treatment would be \$408 million. This high capital cost is dictated by the capacity of the treatment facilities, which are sized to recharge the desired amount of water within the six month off-peak period (October through March). Delivery of water for recharge during the peak demand months (April through September) is unlikely due to the need to serve direct users of Coachella Canal water and Metropolitan's need to meet demands in its service area with Colorado River water.

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Table 2
Pre-Recharge Perchlorate Treatment Costs

	Whitewater Spreading Grounds	Dike 4	Martinez	Total
Capital Cost				
Ion Exchange	\$180,000,000	\$51,430,000	\$51,430,000	\$282,860,000
Contingency	\$45,000,000	\$12,860,000	\$12,860,000	\$70,720,000
Construction Cost	\$225,000,000	\$64,290,000	\$64,290,000	\$353,580,000
Engg & Admin	\$33,750,000	\$9,650,000	\$9,650,000	\$53,050,000
Land	\$140,000	\$40,000	\$40,000	\$220,000
Capital Cost	\$258,890,000	\$73,980,000	\$73,980,000	\$406,850,000
Operating Cost				
Amortized Capital	\$20,260,000	\$5,790,000	\$5,790,000	\$31,840,000
Fixed O&M	\$5,180,000	\$1,480,000	\$1,480,000	\$8,140,000
Salt	\$6,710,000	\$1,920,000	\$1,920,000	\$10,550,000
Total	\$32,150,000	\$9,190,000	\$9,190,000	\$50,530,000
Annual Flow (acre-ft/yr)	140,000	40,000	40,000	220,000
Unit Cost (\$/acre-ft)	\$230	\$230	\$230	\$230

The total annual cost for all three facilities would be \$50.5 million per year. Of this amount, about \$40.8 million would be borne by CVWD and \$9.7 million by DWA. This expenditure would increase CVWD's annual domestic water operating costs by 110 percent compared to current annual expenditures. This would require domestic water rates to more than double compared to current rates.

As noted previously, these costs do not include brine disposal. Approximately 100 tons of salt per year would be required for regeneration. The brine would contain large amounts of perchlorate as well as nitrate and sulfate. It is expected there would be significant environmental issues associated with brine disposal including land use, biological and cultural resources, and water quality.

Reverse osmosis treatment would remove salt (TDS) including perchlorate from the water. The cost for reverse osmosis treatment for the above recharge water flows to a TDS of 300 mg/L would be approximately \$244 to \$330/acre-ft as presented in the Appendix I of the Draft PEIR. These costs are from 5 percent to over 40 percent higher than that for ion exchange.

Facilities for post-recharge treatment of extracted water could have smaller capacities, since only drinking water supply would require treatment if their perchlorate concentrations exceeded the future perchlorate MCL. Water pumped for golf course irrigation or other non-potable uses would not receive treatment because perchlorate is not an issue for these uses. There are

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approximately 45 domestic water supply wells in the Upper Valley that could potentially be affected by water recharged at the Whitewater Spreading Facility based on data presented in the draft PEIR. These wells have an average capacity of about 2500 gpm (3.6 mgd, 162 mgd total). In addition, it is assumed that there are about 20 domestic wells in the Lower Valley that could be affected by recharge at the Dike 4 and Martinez Canyon sites with average capacities of about 500 gpm (0.7 mgd each, 14 mgd total). It is unlikely that all of these wells would experience elevated perchlorate concentrations due to dilution with native groundwater. Therefore, this estimate is extremely conservative.

If treatment were provided for all of these potentially affected wells, the total capital cost would be about \$200 million and the total annual cost would be about \$23 million, exclusive of brine disposal as shown in Table 3. Allocating the cost of treatment between DWA and CVWD based on their relative share of groundwater production results in about \$6.3 million in additional cost for DWA and \$16.4 million for CVWD. For CVWD, this cost represents a 50 percent increase in the current cost of domestic water.

Table 3
Groundwater Perchlorate Treatment Costs

	Whitewater Spreading Grounds	Dike 4	Martinez	Total
Capital Cost				
Ion Exchange	\$116,640,000	\$7,780,000	\$2,600,000	\$127,020,000
Contingency	\$29,160,000	\$1,950,000	\$650,000	\$31,760,000
Construction Cost	\$145,800,000	\$9,730,000	\$3,250,000	\$158,780,000
Engg & Admin	\$21,870,000	\$1,460,000	\$490,000	\$23,820,000
Land	\$100,000	\$20,000	\$20,000	\$140,000
Capital Cost	\$167,770,000	\$11,210,000	\$3,760,000	\$182,740,000
Operating Cost				
Amortized Capital	\$13,130,000	\$880,000	\$300,000	\$14,310,000
Fixed O&M	\$3,360,000	\$230,000	\$80,000	\$3,670,000
Salt	\$4,350,000	\$290,000	\$100,000	\$4,740,000
Total	\$20,840,000	\$1,400,000	\$480,000	\$22,720,000
Annual Flow (acre-ft/yr)	90,720	6,048	2,016	98,784
Unit Cost (\$/acre-ft)	\$230	\$231	\$238	\$230

CONCLUSION

Given the uncertainty associated with the future drinking water standard for perchlorate, the current low concentrations in Colorado River water, the on-going clean-up activities in Las Vegas Wash, the expected reduction in future perchlorate concentrations, the high cost of

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treatment and uncertainties associated with brine disposal, CVWD believes treatment for perchlorate prior to recharge is not economically feasible and may not be necessary due to the on-going source control efforts at Las Vegas Wash. The cost of pre-treatment would more than double the cost of domestic water. Wellhead treatment could increase domestic water costs for CVWD by about 50 percent.

TORRES MARTINEZ
DESERT CAHUILLA



MAU-WAL-MAH
SU-KUTT-MENVIL

THE TORRES MARTINEZ DESERT CAHUILLA INDIANS

P.O. Box 1160 - 66-725 Martinez Road

Thermal, CA 92274

(760) 397-0300 • FAX (760) 397-1019

RECEIVED

AUG 26 2002

C.V.W.D

August 21, 2002

Tom Levy, Manager
Coachella Valley Water District
P.O. Box 1058
Coachella, California 92236

RE: Your fax dated 8/19/02 in response to our Water Quality Standards

Dear Mr. Levy:

At this time we are unable to supply you with the documentation that you have requested in your fax. Our Water Quality Standards documentation is currently under legal review in house and with U.S. EPA.

Documentation will be made public when we have finalized the revisions that we are currently under going and the document is out for public comment.

Sincerely,
Tribal Council, and;

Mary E. Belardo
Tribal Chairwoman

C: Wayne Natri, U.S. EPA Regional Administrator (Region IX) Sent via fax
Virgil Townsend, BIA Superintendent (Southern California Agency) Sent via fax
Alberto Ramirez, Torres Martinez Tribal Environmental Protection Agency Director

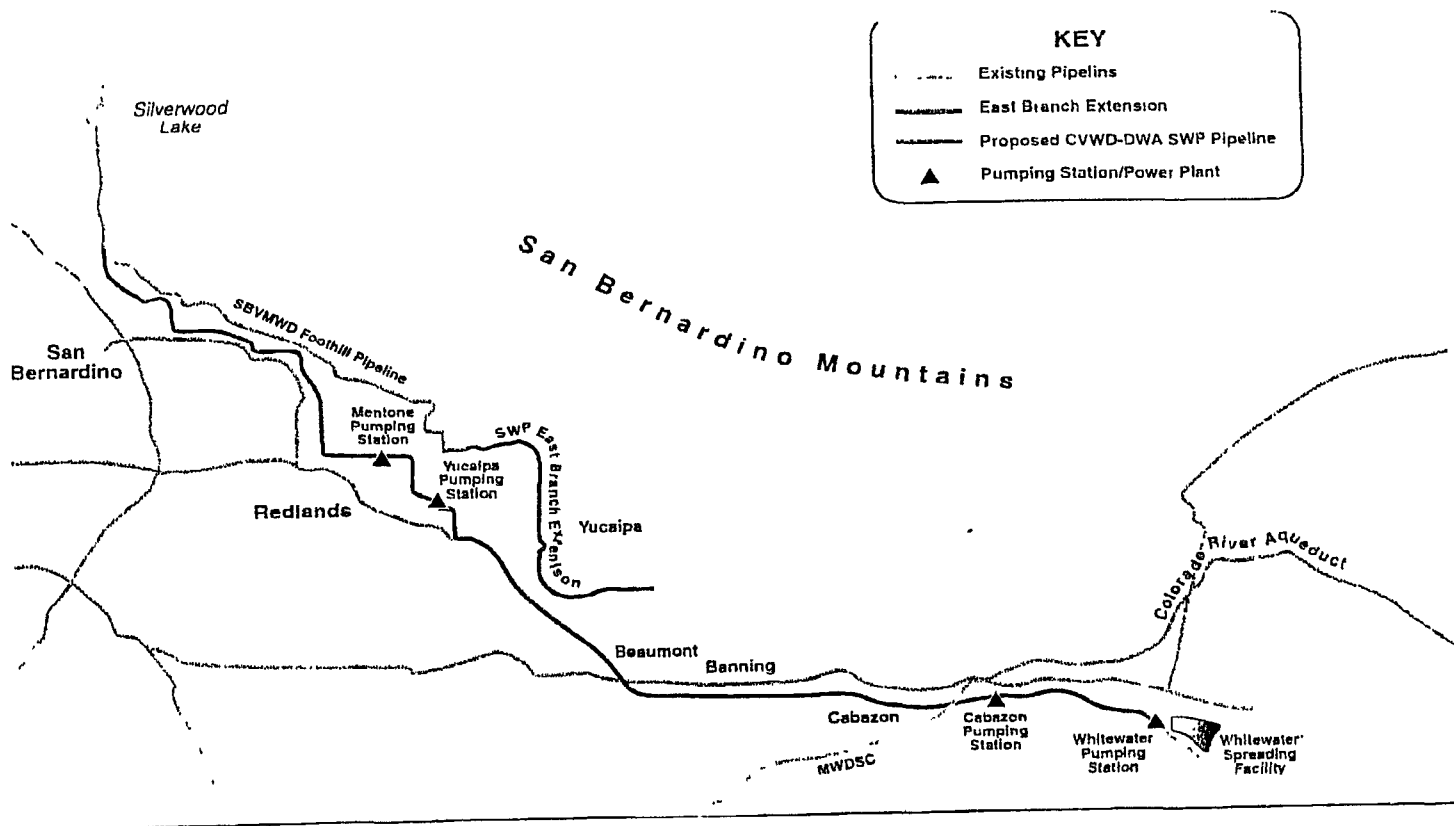


Figure I-1
Conceptual Alignment for SW

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To	Kevin Mayer	From	Hugh Mireles T.M.E.P.A.
Co/Dept.	U.S. E.P.A.	Co.	Torres-Martinez
Phone #	415-972-3176	Phone #	760-397-8145
Fax #	415-947-3528	Fax #	760-397-0607

For your information
Any Questions Call
Alberto Ramirez
Torres-Martinez E.P.A. Direct,

Thank
you
Hugh Mireles